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Drive device for a front-loading washing machine

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Drive Device for a Front Loading Washing Machine

ABSTRACT

The drive in the form of a direct drive device for a front-loading washing machine is to be structured to enable adequate cooling of the stator windings by the ambient air so that the motor of adequate size cannot overheat in proper operation.

To this end, the stator (10), instead of the usually employed stiff carrier part, is connected with the rear wall (6) of the washing liquid container and comprises a central bearing sleeve (26) for the shaft (7) of the laundry drum (4) at the outer end of which the rotor (13) of the motor (9) is attached in a central position. Magnetisable poles (14), which are distributed over the periphery of the rotor, face from the inside across a minimum air gap to the lamination stacks (35) which are distributed at the inner periphery of a flange (11) integrated into the stator (10) and provided for reception of excitation windings (12) of the stator (10).

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ORIGINAL

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Invention Title: Drive Device for a Front-Loading Washing Machine

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

DRIVE MEANS FOR A FRONT-LOADING WASHING MACHINE

The invention relates to drive means for a front-loading washing machine. Such drive means are known from GB 2,202,867 A. However, there the stator forms only part of the support means for the drive shaft of the laundry drum; the other bearing support is formed by the rotor of the motor. In this way, the known drive means are hard to mount and to adjust. Disturbance-free running of the motor therefore cannot be ensured. Furthermore, the known drive means do not show direct driving of the laundry drum by the motor because at the rear of the motor there is interposed a planet wheel gear which greatly steps down the rotational motion of the motor and, besides that, reversed the direction of rotation. This results in encapsulation of the motor to an extent such that adequate cooling is at risk; it becomes too hot during operation. Apart from this, the known drive means are very long because of the additional gear. Accommodating the known drive means in a usually narrow washing-machine housing therefore might be very difficult.

Other drive means are known from FR-A 1,340,648. There the stator is attached as a separate part of the motor to the rigid support element for the rear wall of the suds vessel. In this way the known motor at the stator does not have a central bearing sleeve which could automatically provide proper centering of the shaft for the laundry drum. In order to cool the motor, a special vane disk is mounted before the rotor but it has but little effect during the slow rotation of the motor when the laundry drum is driven with the rate of rotation of washing (approximately 50 rpm at the drum and at the rotor). It may be interfering rather than helpful as a structural element closing the motor area.

In the drive means known from DE 43 41 832 A1, the stator of the motor configured as a collector-less external rotor DC motor is fastened directly on the bearing sleeve of the rigid support element. The shaft is supported in the bearing sleeve and joined in non-rotational fashion at its outer end with the rotor of the motor. This rotor is a so-called external rotor which in the form of a pot encloses the stator coils and has poles in the form of permanent magnets. The motor is additionally enclosed by a damping hood which attenuates noise emitted from the motor directly into the ambient atmosphere.

The drive means known from DE 43 41 832 AL encapsulate the stator which, because of heat generated in its windings by currents, is exposed to a considerable thermal load, by a pot-shaped rotor and, in addition, by the noise-absorbing hood to an extent such that no cooling of the motor takes place. This is further aggravated by the

fact that, owing to its necessarily low intrinsic rated of rotation, such a directly driving motor can hardly have intrinsic cooling through its slowly running rotor. Therefore, the known drive means are useable in practice only if they are protected from rapid overheating by external cooling.

It is therefore desirable to configure the above-described drive means in such a way that cooling of the stator windings by ambient air is unproblematically ensured and that, in proper operation and with appropriate dimensions, the motor is unlikely to overheat.

It is the object of the present invention to substantially overcome or at least ameliorate one or more of the above disadvantages.

Accordingly, the present invention provides a drive device for a front-loading washing machine having a suds vessel and a laundry drum, said laundry drum being mounted by way of a substantially horizontal shaft within a bearing sleeve of a rigid support element, said rigid support element being mounted at the rear wall of said vessel, said shaft being driven directly by a motor mounted at said rear wall of said suds vessel, said motor having a rotor and a stator wherein:

said rotor has a shaft which is short in comparison with its diameter, said stator is integral with said rigid support element and said bearing sleeve is provided at the centre of said stator;

said rotor is mounted on said shaft in centered position and in non-rotatable fashion relative to the laundry drum and mounted such that magnetisable poles distributed over the periphery of said rotor radially oppose armature stampings across an extremely small air gap, said armature stampings being distributed over an inner periphery of a flange, said flange being integral with said stator and accommodating field coils; and

wherein parts of the rotor are configured to enhance air movement developing during rotational motion.

In a preferred embodiment, the motor has an open structure and accordingly, the heat-generating parts, particularly the stator windings on the outside of the motor, can be cooled by the ambient air from all sides. Configuring parts of the rotor so that they enhance the air movement helps to obtain a sufficient cooling effect even at the low rates of motor rotation during the washing process.

If, according to an advantageous embodiment of the invention, the motor is an electronically commutated DC motor, the generation of heat can be dept very low.

Maintenance work involving carbon brushes is not required. The service life is limited only by possible wear of bearings.

In a particular advantageous embodiment of the invention, the rotor is provided with an enclosing pack of laminated sheets and permanent-magnet segments arranged thereon. The permanent-magnet segments render a powerful torque and the laminated sheets ensure a particularly good magnetic flux. The manufacture of the required packs of laminated sheets is relatively uncomplicated and inexpensive especially for a motor having an internal rotor, since the winding process has been automated.

In order to simplify the form of the rotor and of its parts, and also of the parts enhancing the air movement, the rotor may be configured as carrier for the pack of laminated sheets and the parts for enhancing the air movement can be spokes arranged in the form of a star. In this way, one can do without additional components which may be advantageously supported by the stator's packs composed of laminated sheets.

For easy and reproducibly accurate assembly, a centering nonrotatable screw attachment of the rotor at the shaft may be supplemented by means of form-locking profiled shaft keying, profiled hub keying, keying by a feather key, conical keying or key-bed junction.

A preferred form of the present invention will now be described by way of example with reference to the accompanying drawings, wherein:

Fig. 1 is a schematic representation of a washing-machine suds vessel with an internally supported horizontal laundry drum, to the drive shaft of which the rotor of a motor according to the invention is affixed by means of a flange; and

Fig. 2 is an enlarged, partially sectional detail of the motor of Figure 1 mounted at the rear wall.

The suds vessel 1 is supported for vibration in a manner not shown in detail within a housing of a washing machine, likewise not illustrated. It has at its front wall 2 an opening 3 for the rear wall 6 of the suds vessel 1. Shaft 7, which at the rear wall 8 of the laundry drum 4 is joined with the same in a manner not allowing relative rotation, is used for this purpose.

At the rear wall 6 of the suds vessel 1 there is mounted a motor 9 the stator support element 10 of which is joined with the rear wall 6 so as not to allow relative rotation. Stator windings 12 are distributed over the are surface of the flange 11 of the stator support element 10 and, during rotation of the rotor 13, alternatively correspond to the poles 14 which are formed by permanent magnets and are likewise distributed in

segment-like fashion over the periphery of the rotor. The Magnetic flux of the magnet segments 14 is closed by a pack of laminated sheets 16 wound onto the rim 15. In this way, the motor can apply its driving torque directly to the laundry drum 4 via the axle end 7.

As shown in Figure 2, the rear wall 8 of the laundry drum 4 is reinforced by a star-shaped support element 17 the hub 18 of which is connected with an axle end 7 in a manner not allowing relative rotation. Furthermore, the stator support element 10 is fixed by screws at the rear wall 6 of the suds vessel 1 in a manner not allowing relative rotation (screws 19). For a mechanic assembling washing machines in the washing-machine manufacturing plant to be able to mount the support element 10 at the rear wall of the suds vessel, access openings 20 are provided above the screws 19 in the support element. The rotor disk 13 has anyhow spokes 21 between its hub 22 and the rim 15 which serves a as a support ring for the magnet segments 14, so that easy access through the gaps between the spokes is available.

Furthermore, the stator support element 10 has on its outer periphery several, preferably three, fastening lugs 23 distributed over the circumference of the suds vessel 1, which by means of screws 24 provide an additional firm connection with the suds vessel via brackets 25 welded to the suds vessel 1.

The bearing sleeve 26 of the stator support element 10 forms seats 27 and 28 for roller bearings 29 and 30 the inner rings of which are placed with adequate fit onto the axle end 7 of the laundry drum 4 and, at its extremity, secured by means of a thrust washer 31 and a central screw 32 so that they join the rotor 13 via its hub 31 and the inner journals of the roller bearings 29 and 30 with the laundry drum in a manner not allowing relative rotation. Between the hub 18 of the star-shaped support 17 of the laundry drum 4 and the inner journal of the roller bearing 29 there is pressed in a spacer ring 33 which is polished on its outside. A sealing ring 34, the sealing edges of which on the side of the shaft are retained on the polished outside of the spacer ring 33 by means of a spring ring, is connected with a step on the bearing sleeve 26. Its sealing edges pointing to the rear wall 6 of the suds vessel 1 bear with axial pressure on a likewise polished ring surface of the rear wall plate. In this way suds tending to leave the suds vessel are prevented from exiting.

The motor can be a so-called switched reluctance motor. In that case, the rim of the rotor or the support surface of the same is made from a ferro-magnetically relatively poorly conducting material. The structure of the stator can be compared with that of an

electronically commutated DC motor. The advantage of the reluctance motor results mainly from a less expensive design of the rotor (not expensive magnetic materials).

In order to achieve increased safety against relative rotation of the rotor 13 and the shaft 7, the fastening of the rotor 13 at the shaft 7 by screws 31,32 can be supplemented in form-locking fashion by means of profiled shaft keying, profiled hub keying, keying by a feather key, conical keying or a key-bed junction (not shown).

The claims defining the invention are as follows:-

1. A drive device for a front-loading washing machine having a suds vessel and a laundry drum, said laundry drum being mounted by way of a substantially horizontal shaft within a bearing sleeve of a rigid support element, said rigid support element being mounted at the rear wall of said vessel, said shaft being driven directly by a motor mounted at said rear wall of said suds vessel, said motor having a rotor and a stator wherein:

said rotor has a shaft which is short in comparison with its diameter, said stator is integral with said rigid support element and said bearing sleeve is provided at the centre of said stator;

said rotor is mounted on said shaft in centered position and in non-rotatable fashion relative to the laundry drum and mounted such that magnetisable poles distributed over the periphery of said rotor radially oppose armature stampings across an extremely small air gap, said armature stampings being distributed over an inner periphery of a flange, said flange being integral with said stator and accommodating field coils; and

wherein parts of the rotor are configured to enhance air movement developing during rotational motion.

2. The drive device according to Claim 1, wherein said motor is an electronically commutated DC motor.

3. The drive device according to Claim 2, wherein said rotor is provided with a pack of laminated sheets and permanent-magnet segments arranged thereon.

4. The drive device according to any one of Claims 1 to 3, wherein said rotor is configured as a carrier for said pack of laminated sheets and said parts for enhancing the air movement are spokes arranged in the form of a star.

5. The drive device according to any one of Claims 2 to 4, wherein said armature stampings of said stator are composed of core sheets and bear coils with the field windings.

6. The drive device according to any one of Claims 1 to 4 wherein a centering screw attaches said rotor to said shaft, the rotation of said screw attachment being prevented by form-locking profiled shaft keying, profiled hub keying, keying by a feather key, conical keying or a key-bed junction.

7. A drive device for a front-loading washing machine, said device being substantially as hereinbefore described with reference to the accompanying drawings.

Dated 18 August, 2000
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FIG. 1

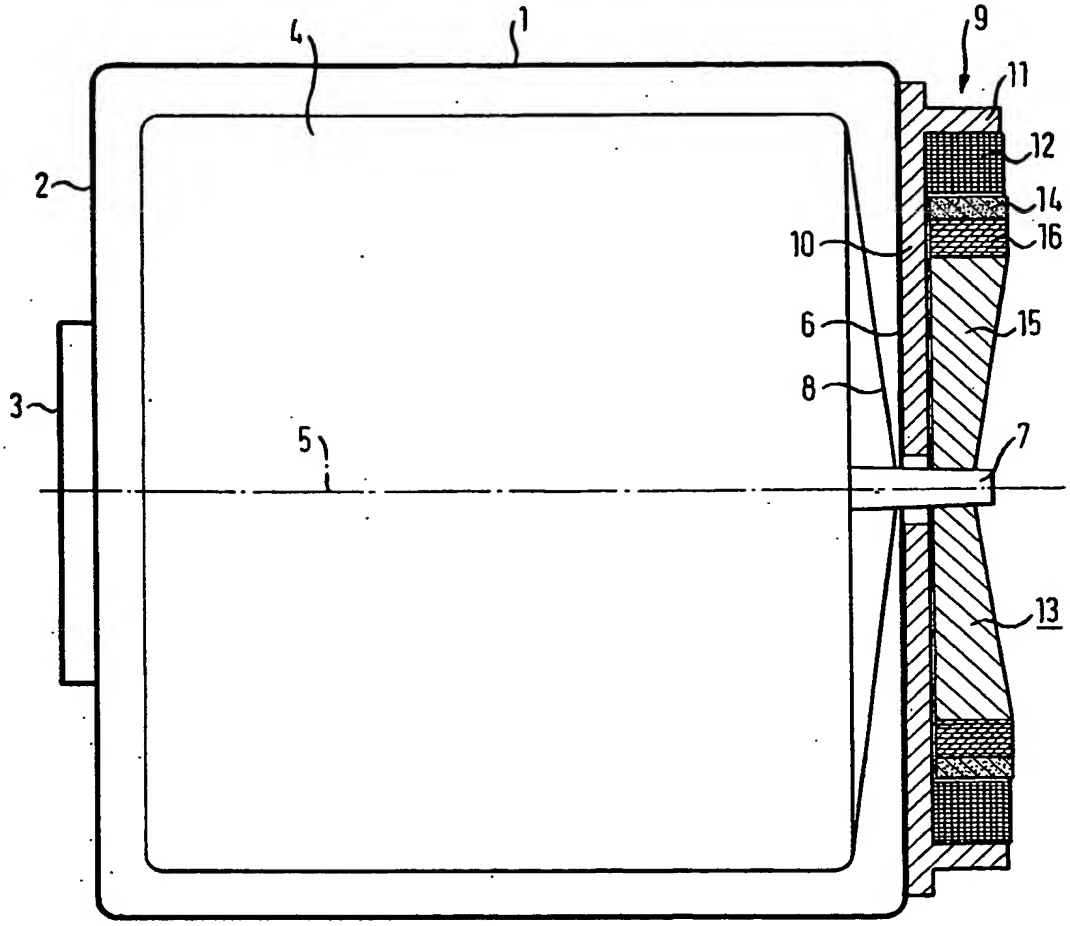

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FIG. 2